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PITTSBURG, PA.

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Westinghouse Electric & Manufacturing Co.

PITTSBURG, PA.

Circular 1077 — March, 1904

TYPE L MOTORS

Direct Current Series Wound

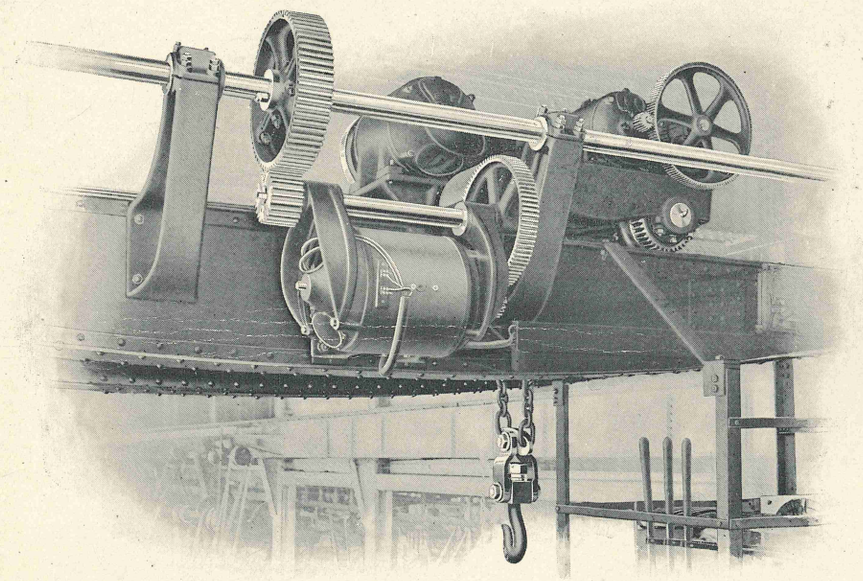


FIG. 1—ELECTRIC CRANE DRIVEN BY TYPE L MOTORS

TYPE L MOTORS

Direct Current Series Wound

The Westinghouse Type L Motor is widely used for hoisting or other intermittent service requiring a large starting torque. Being of the enclosed type to protect it against the entrance of dust or dirt, it is well suited for work in mills, foundries and other manufacturing plants.

The Type L Motor is series wound for direct current, that is, the current passes through the armature and then directly through the field winding, and since the torque of a motor is approximately

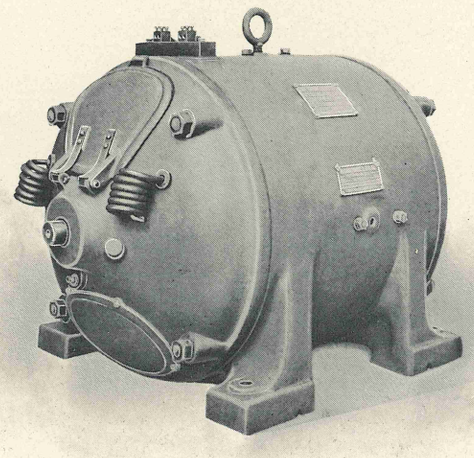


FIG. 2—TYPE L MOTOR.

proportional to the product of the armature current by the field strength, the torque of a series motor, up to the point of saturation of the magnetic circuit, increases very nearly as the square of the current. It is therefore well adapted for starting and accelerating heavy loads. The speed of the motor, which is controlled by varying the electromotive force applied at the armature terminals, is changed by inserting resistance in the circuit, and the control is accomplished through a controller which is immediately under the hand of the operator. The controllers employed in this work are shown on page 7.

Type L Motors are wound for 110, 220 and 500 volts on frames designated by numbers. Performance curves are presented elsewhere giving the output of the 220-volt motors for different speeds. The performance of the 110 and 500 volt motors is approximately the same.

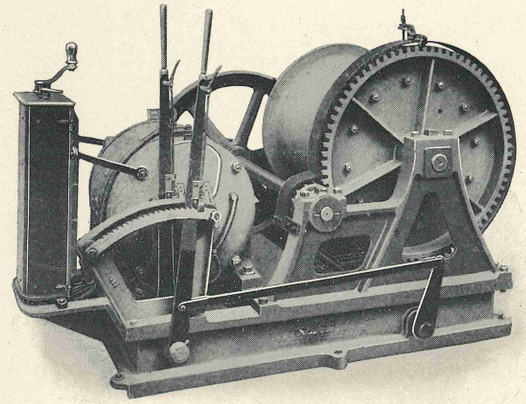


FIG. 3—ELECTRIC HOIST DRIVEN BY TYPE L MOTOR.

A motor which is intended to be used as a hoist motor is provided with a shaft extended at the commutator end for carrying a brake wheel. The dimensions of motors with this shaft extension will be found in the tables on pages 8 and 9.

Field Frame. — The field frame is made in one cylindrical piece and it is closed by two end brackets bolted tightly to the frame. The end brackets carry self-oiling and self-aligning bearings.

There is a large opening in the front end bracket over the commutator which gives easy and convenient access to the interior of the motor. The rear

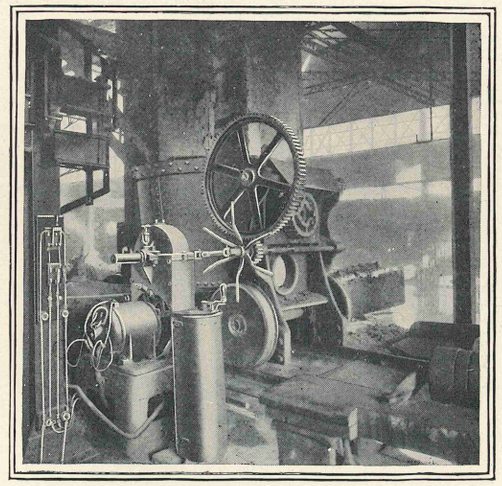


FIG. 4, NO. 2 TYPE L MOTOR—220 VOLTS.
Operating Ladle Tipper in Converting Department of National Steel Co., Youngstown, O.

bracket has a similar opening. These openings are covered by tightly fitting spring lids hinged to the brackets. In the illustration Figure 6 it will be noticed that the spring lid carries on its inner surface a second lid which fits closely over the bearings and prevents any dust finding its way to the interior of the bearing. Suitable openings in the lower part of each end bracket give access to the motor from below. These are closed by covers.

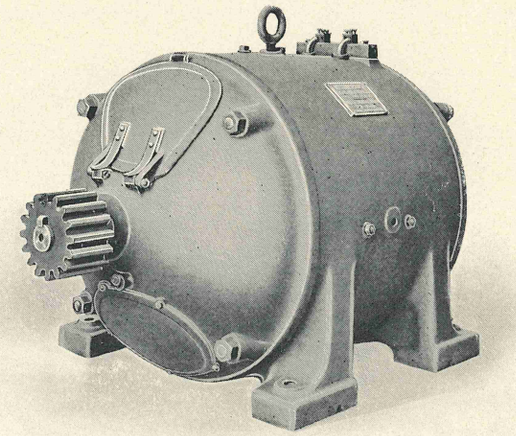


FIG. 5—TYPE L MOTOR FROM PINION END.

If the motor is to be attached to either the ceiling or the wall, the position of the end brackets may be arranged so that the bearings will be in the proper position.

Pole Pieces and Field Coils.—There are four pole pieces which project radially inward at an angle of 45° with the horizontal. Each is built up of sheet steel punchings riveted together between wrought iron end plates. The completed pole pieces are cast in the frame. The pole face is smooth and solid.

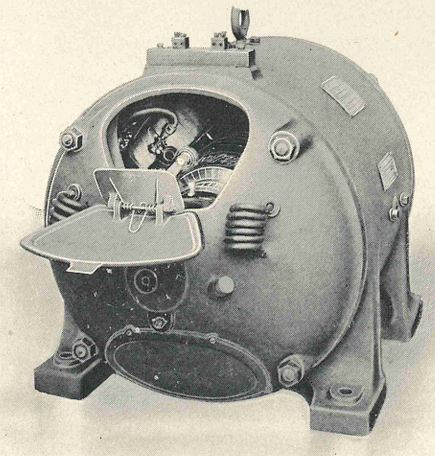


FIG. 6—TYPE L MOTOR WITH LID OPEN SHOWING THE INTERIOR.

The field coils are machine wound on forms and are therefore perfectly interchangeable in motors of the same size and characteristics. They are wound with double cotton covered round wire and insulated with fullerboard and mica, carefully taped and thoroughly treated with a special compound which makes them moisture proof. Coils are held in position by hangers, and, except in motor No. 2, are connected together by copper straps in such a manner that there can be no annoyance from their breaking.

Armature.—The armature core is built up of thin sheet steel punchings of high permeability, which have been carefully annealed

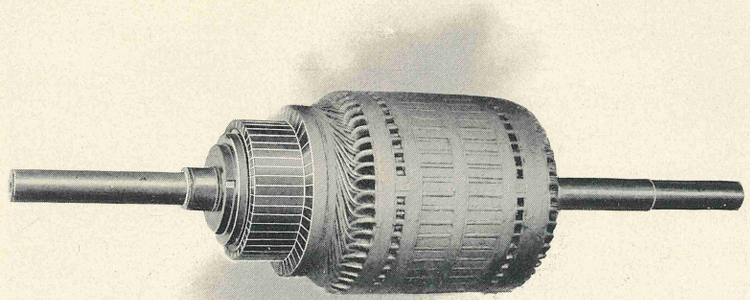


FIG. 7—ARMATURE OF TYPE L MOTOR.

in ovens built especially for that purpose. The punchings are built up directly on the shaft, which is provided with a feather key, and the laminated core thus built up is firmly clamped between end plates. Longitudinal openings permit the free passage of air through the core, and where the dimensions of the core and the coils permit, the ventilation is increased by radial ducts perpendicular to the axis of the core. When the motor is running air is drawn in through the core and forcibly thrown from the ducts through the armature windings against the pole pieces and field coils, thus providing an interior circulation of air that keeps the armature and the field coils at a uniform temperature.

The coils are placed in slots in the core and they are continuous throughout their length, with no joints except where they connect with the neck of the commutator. They are encased in insulating envelopes of fullerboard and retained by surface bands.

In the armatures and commutators only the best obtainable grade of insulating material is used, and the endurance of the motor is as much to be ascribed to this fact as to its superiority of design.

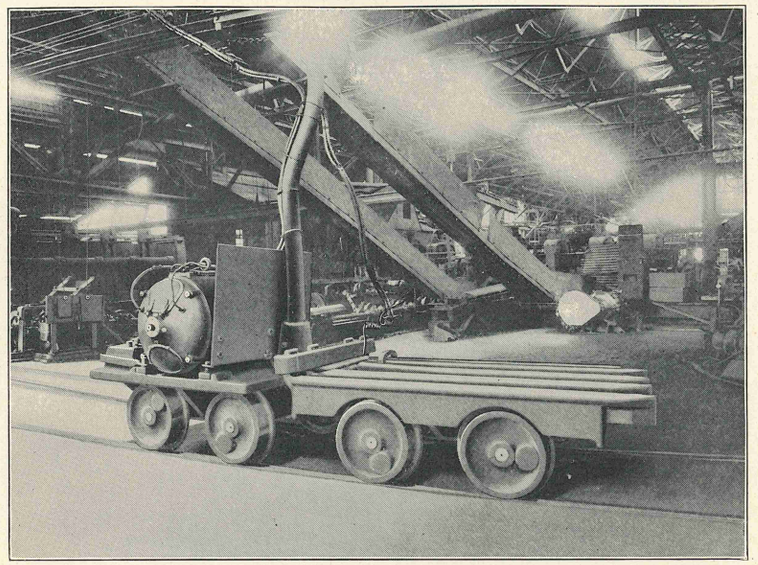


FIG. 8—ELECTRIC BLOOM CARRIAGE DRIVEN BY TYPE L MOTOR.

Commutation.—Excellent commutation and freedom from sparking are very necessary to a series type of motor which starts off under a heavy rush of current and handles fluctuating loads during service. These are characteristics which very largely achieved the success of the Westinghouse multipolar motor, and they as largely characterize the performance of the Type L motor.

The commutator is constructed of cold rolled copper and a high-grade carbon brush is used upon it, giving it a glossy commutator surface and minimum wear of commutator and brushes.

Controllers.—Two types of controllers, each giving excellent speed control, are used with Type L motors. The face plate type

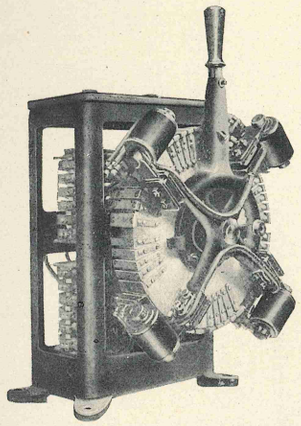


FIG. 9—REGULATING AND REVERSING CONTROLLER.
For Nos. 7 and 8 Type L Motors

of controller shown in Figure 11 is used, except with the No. 7 and No. 8 Motors, for which a commutator type of controller is provided, as shown in Figure 9. This type of controller, when used for crane service, may be placed directly in the crane cage and moved by hand, or it may be mounted on a resistance frame and operated by a bell crank and lever, as shown in Figure 10. Each of these controllers has a soapstone dial plate, upon which are arranged four sets of contact segments. The dial plate is mounted upon an iron frame containing the necessary resistances and over its surface moves a rocker arm carrying four brush holders and a powerful magnetic blow-out. Ordinarily the rocker arm is directly operated by a handle, but it may be provided with a bell crank and lever, as shown.

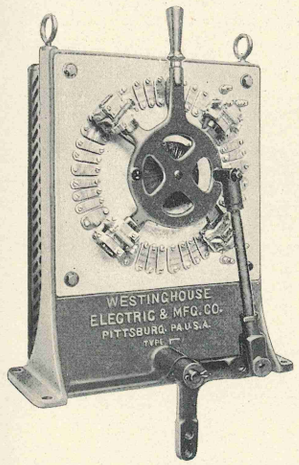


FIG. 11 — CONTROLLER USED WITH TYPE L MOTOR UP TO NO. 7 SIZE.
The Bell Crank and Connecting Rod is not ordinarily furnished with this Controller.

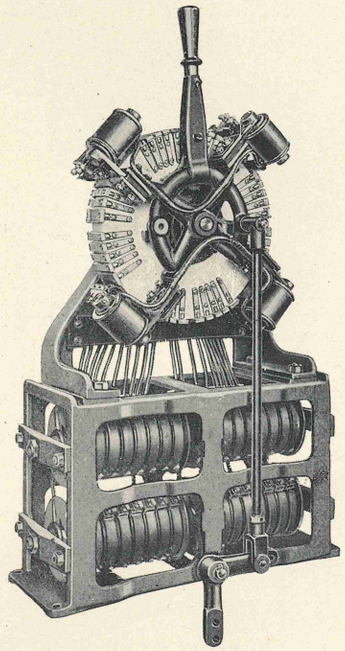
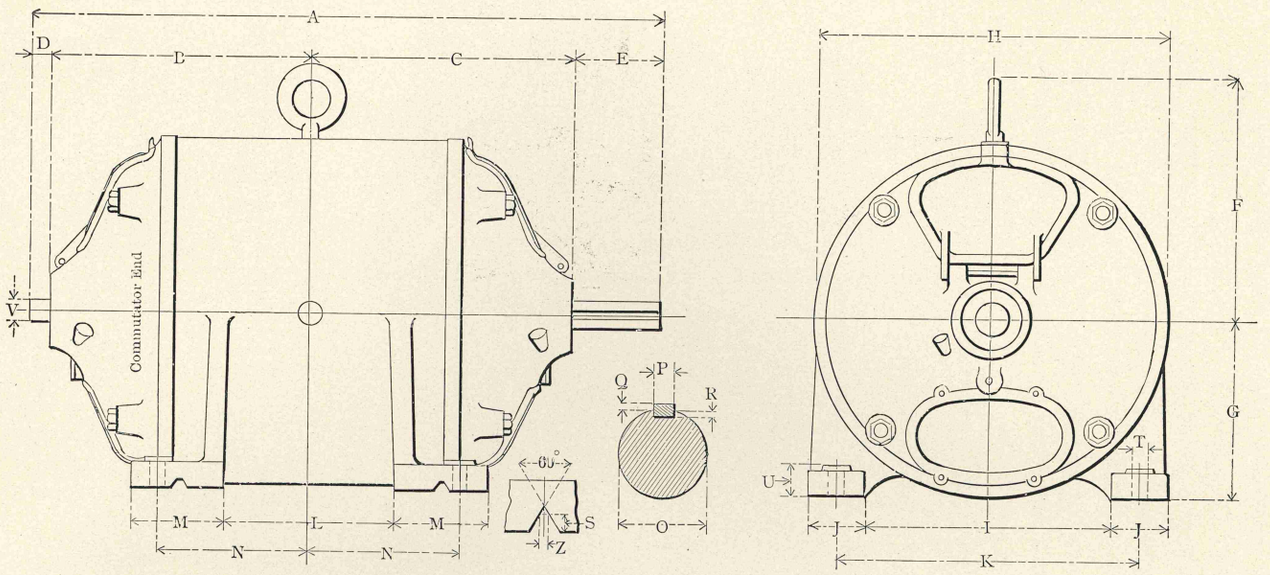


FIG. 10—REGULATING AND REVERSING CONTROLLERS.
Mounted on Resistance Grids and Equipped with Bell Crank and Connecting Rod for use with a Lever.

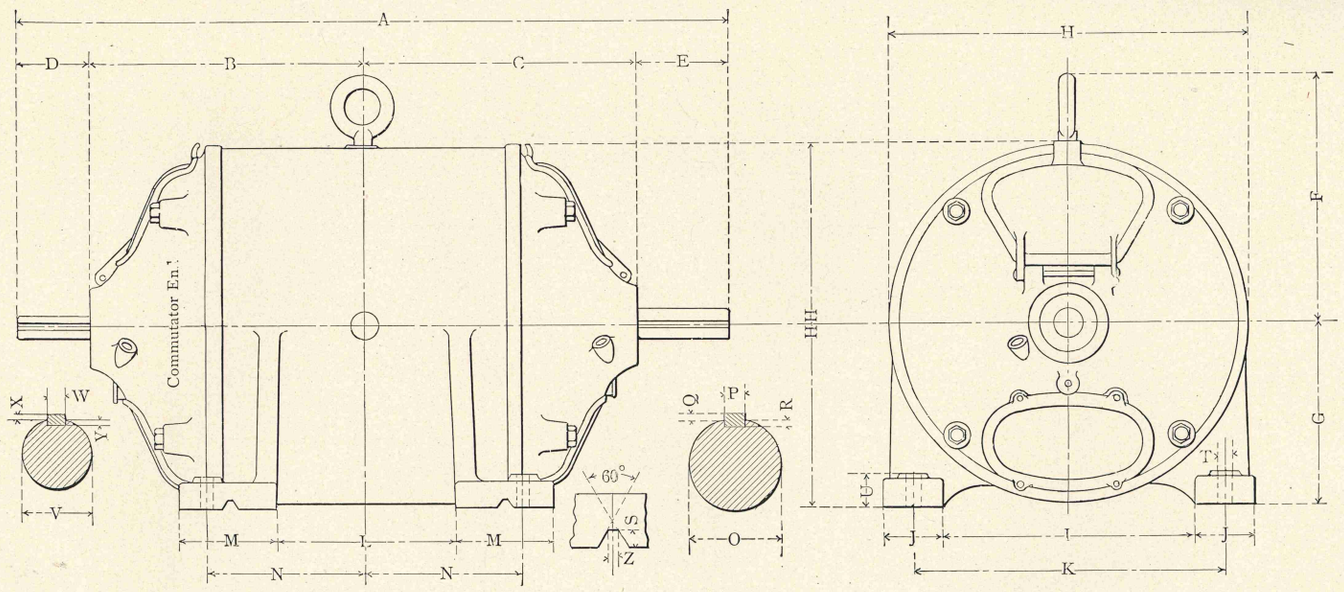
The controllers are exceedingly compact and yet all their parts are readily accessible and the whole apparatus requires but little space.



TYPE L MOTORS

Series wound for 110, 220 and 500 Volts. Approximate Dimensions in Inches.

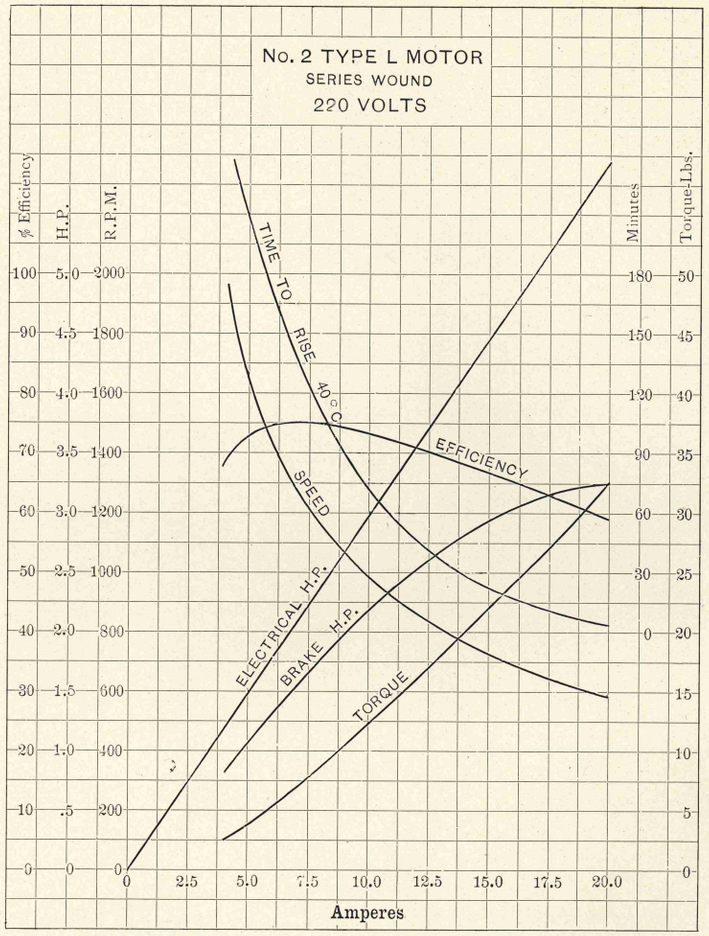
No.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	Key Way in Shaft P	Key Way in Shaft Q	Key Way in Shaft R	S	T	U	V	Z	Average Net Wt. Lbs
2	$26\frac{3}{16}$	$11\frac{1}{4}$	$11\frac{1}{4}$	$\frac{5}{8}$	$3\frac{1}{16}$	$10\frac{1}{4}$	$7\frac{3}{4}$	15	$10\frac{1}{2}$	$2\frac{1}{2}$	13	$7\frac{1}{2}$	3	$5\frac{5}{8}$	$1\frac{3}{16}$	$\frac{5}{16}$	$\frac{7}{64}$	$\frac{7}{64}$	$\frac{3}{8}$	$\frac{3}{4}$	$1\frac{1}{4}$	1	$\frac{1}{4}$	310
3	32	$13\frac{2}{3}\frac{3}{2}$	$13\frac{2}{3}\frac{3}{2}$	$\frac{9}{16}$	4	13	$9\frac{1}{4}$	$18\frac{1}{4}$	$12\frac{7}{8}$	3	$15\frac{7}{8}$	$9\frac{3}{4}$	4	$7\frac{5}{8}$	$1\frac{7}{16}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{8}$	$1\frac{1}{4}$	$\frac{1}{4}$	560
4	36	$14\frac{2}{3}\frac{9}{2}$	$14\frac{2}{3}\frac{9}{2}$	$1\frac{3}{16}$	5	$13\frac{3}{4}$	10	$19\frac{3}{4}$	14	$3\frac{1}{4}$	$17\frac{1}{4}$	$9\frac{3}{4}$	$5\frac{3}{8}$	$8\frac{5}{8}$	$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{3}{4}$	$1\frac{1}{4}$	$\frac{1}{4}$	810
5	38	16	16	1	5	$14\frac{3}{4}$	11	$21\frac{3}{4}$	$15\frac{5}{8}$	$3\frac{1}{2}$	$19\frac{1}{8}$	$9\frac{3}{4}$	6	$9\frac{1}{4}$	$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	2	$1\frac{1}{2}$	$\frac{1}{4}$	1000
6	$40\frac{3}{4}$	$16\frac{7}{8}$	$16\frac{7}{8}$	1	6	$16\frac{1}{2}$	$12\frac{1}{2}$	$24\frac{1}{4}$	$18\frac{1}{4}$	$3\frac{1}{2}$	$21\frac{3}{4}$	11	$5\frac{5}{8}$	$9\frac{1}{2}$	$1\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{7}{8}$	2	$1\frac{1}{2}$	$\frac{1}{4}$	1335
7	$44\frac{1}{2}$	$18\frac{1}{4}$	$18\frac{1}{4}$	$\frac{3}{4}\frac{7}{8}$	$7\frac{1}{4}$	$17\frac{7}{8}$	$13\frac{3}{4}$	$26\frac{3}{4}$	$19\frac{3}{4}$	4	$23\frac{3}{4}$	13	$6\frac{1}{2}$	11	$1\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	1	$2\frac{1}{8}$	$1\frac{1}{2}$	$\frac{1}{4}$	1690
8	$50\frac{1}{2}$	$21\frac{1}{4}$	$21\frac{1}{4}$	$\frac{7}{8}$	$7\frac{1}{8}$	$19\frac{5}{8}$	$15\frac{5}{8}$	$30\frac{1}{4}$	$23\frac{1}{2}$	4	$27\frac{1}{2}$	$13\frac{1}{4}$	$7\frac{7}{8}$	$12\frac{1}{2}$	$2\frac{1}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{8}$	1	$2\frac{1}{8}$	2	$\frac{3}{8}$	2700



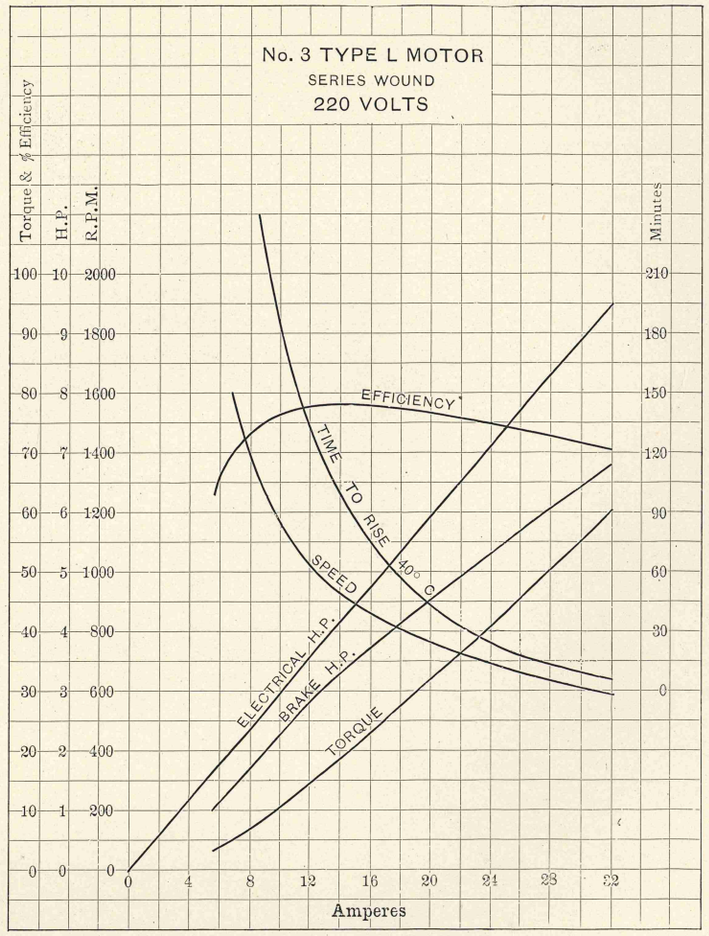
TYPE L MOTORS

With Extended Shaft for Attachment of Brake Wheel, Etc. Series Wound for 110, 220 and 500 Volts.
Approximate Dimensions in Inches.

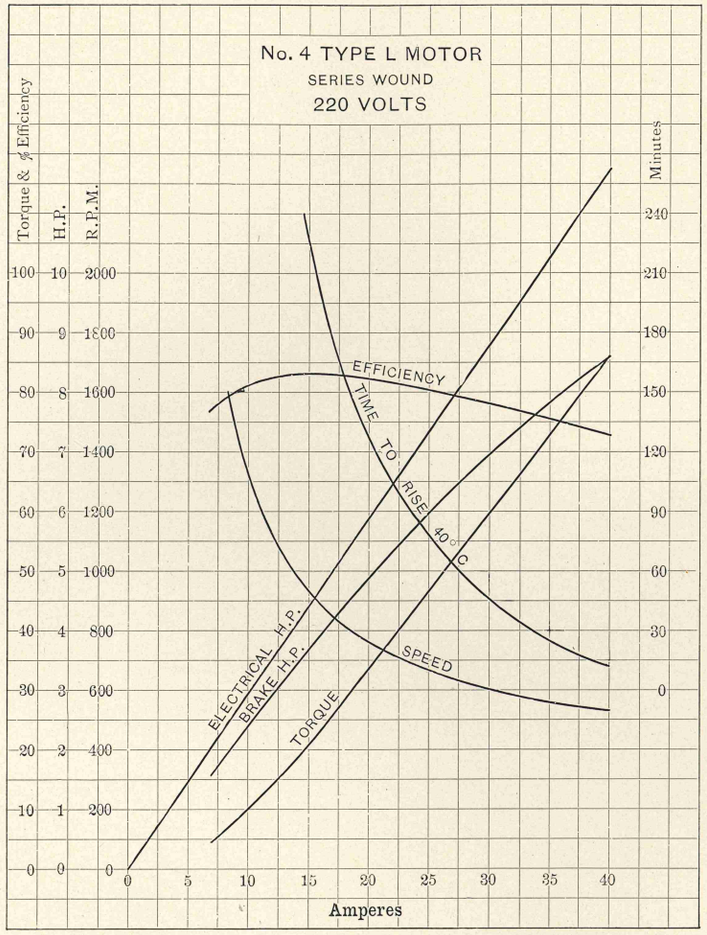
No.	A	B	C	D	E	F	G	H	HH	I	J	K	L	M	N	O	Key Way in Shaft Rear End P	Key Way in Shaft Rear End Q	Key Way in Shaft Rear End R	S	T	U	V	Key Way in Shaft Front End W	Key Way in Shaft Front End X	Key Way in Shaft Front End Y	Z	Average Net Wt. Lbs.
2	$29\frac{9}{16}$	$11\frac{1}{4}$	$11\frac{1}{4}$	4	$3\frac{1}{16}$	$10\frac{1}{4}$	$7\frac{3}{4}$	15	$15\frac{1}{4}$	$10\frac{1}{2}$	$2\frac{1}{2}$	13	$7\frac{1}{2}$	3	$5\frac{5}{8}$	$1\frac{3}{16}$	$\frac{5}{16}$	$\frac{7}{64}$	$\frac{7}{64}$	$\frac{3}{8}$	$\frac{3}{4}$	$1\frac{1}{4}$	1	$\frac{1}{4}$	$\frac{3}{32}$	$\frac{3}{32}$	$\frac{1}{4}$	310
3	$35\frac{7}{16}$	$13\frac{2}{3}\frac{3}{2}$	$13\frac{2}{3}\frac{3}{2}$	4	4	13	$9\frac{1}{4}$	$18\frac{1}{4}$	$18\frac{3}{8}$	$12\frac{7}{8}$	3	$15\frac{7}{8}$	$9\frac{3}{4}$	4	$7\frac{5}{8}$	$1\frac{7}{16}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$1\frac{5}{8}$	$1\frac{1}{4}$	$\frac{5}{16}$	$\frac{7}{64}$	$\frac{7}{64}$	$\frac{1}{4}$	560
4	$38\frac{1}{16}$	$14\frac{2}{3}\frac{9}{2}$	$14\frac{2}{3}\frac{9}{2}$	4	5	$13\frac{3}{4}$	10	$19\frac{3}{4}$	$19\frac{7}{8}$	14	$3\frac{1}{4}$	$17\frac{1}{4}$	$9\frac{3}{4}$	$5\frac{3}{8}$	$8\frac{5}{8}$	$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	$1\frac{3}{4}$	$1\frac{1}{4}$	$\frac{5}{16}$	$\frac{7}{64}$	$\frac{7}{64}$	$\frac{1}{4}$	810
5	41	16	16	4	5	$14\frac{3}{4}$	11	$21\frac{3}{4}$	$21\frac{7}{8}$	$15\frac{5}{8}$	$3\frac{1}{2}$	$19\frac{1}{8}$	$9\frac{3}{4}$	6	$9\frac{1}{4}$	$1\frac{5}{8}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{2}$	$\frac{7}{8}$	2	$1\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	1000
6	$43\frac{3}{4}$	$16\frac{7}{8}$	$16\frac{7}{8}$	4	6	$16\frac{1}{2}$	$12\frac{1}{2}$	$24\frac{1}{4}$	$24\frac{5}{8}$	$18\frac{1}{4}$	$3\frac{1}{2}$	$21\frac{3}{4}$	11	$5\frac{5}{8}$	$9\frac{1}{2}$	$1\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{7}{8}$	2	$1\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	1335
7	$47\frac{3}{4}$	$18\frac{1}{4}$	$18\frac{1}{4}$	4	$7\frac{1}{4}$	$17\frac{7}{8}$	$13\frac{3}{4}$	$26\frac{3}{4}$	$27\frac{1}{4}$	$19\frac{3}{4}$	4	$23\frac{3}{4}$	13	$6\frac{1}{2}$	11	$1\frac{7}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	1	$2\frac{1}{8}$	$1\frac{1}{2}$	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	1690
8	$53\frac{5}{8}$	$21\frac{1}{4}$	$21\frac{1}{4}$	4	$7\frac{1}{8}$	$19\frac{5}{8}$	$15\frac{5}{8}$	$30\frac{1}{4}$	$30\frac{7}{8}$	$23\frac{1}{2}$	4	$27\frac{1}{2}$	$13\frac{1}{4}$	$7\frac{7}{8}$	$12\frac{1}{2}$	$2\frac{1}{8}$	$\frac{5}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{5}{8}$	1	$2\frac{1}{8}$	2	$\frac{3}{8}$	$\frac{1}{8}$	$\frac{1}{8}$	$\frac{3}{8}$	2700



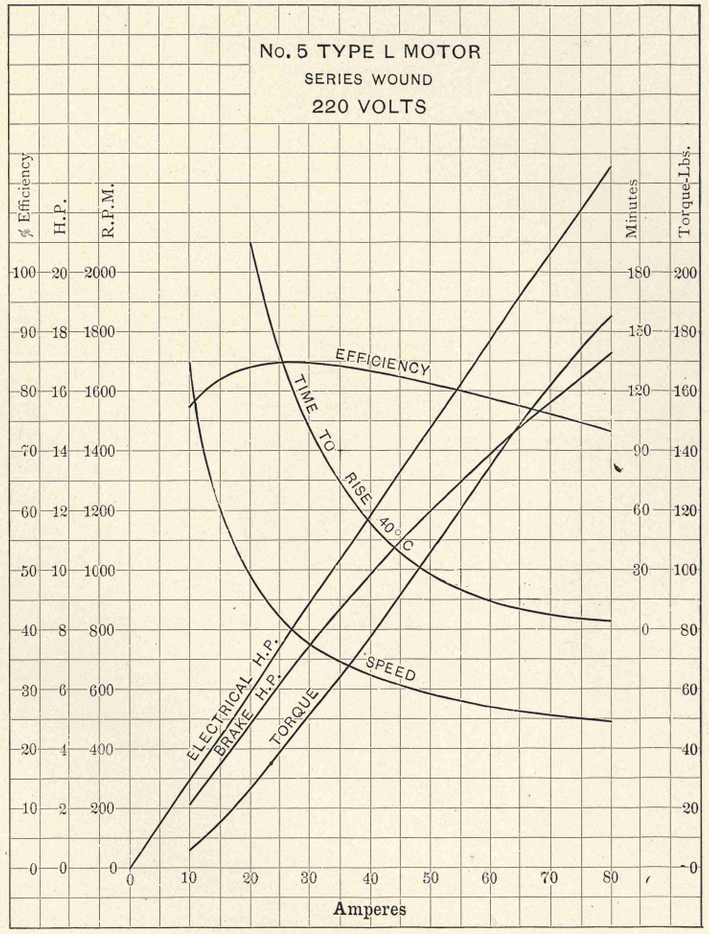
No. 2 Type L Motor.



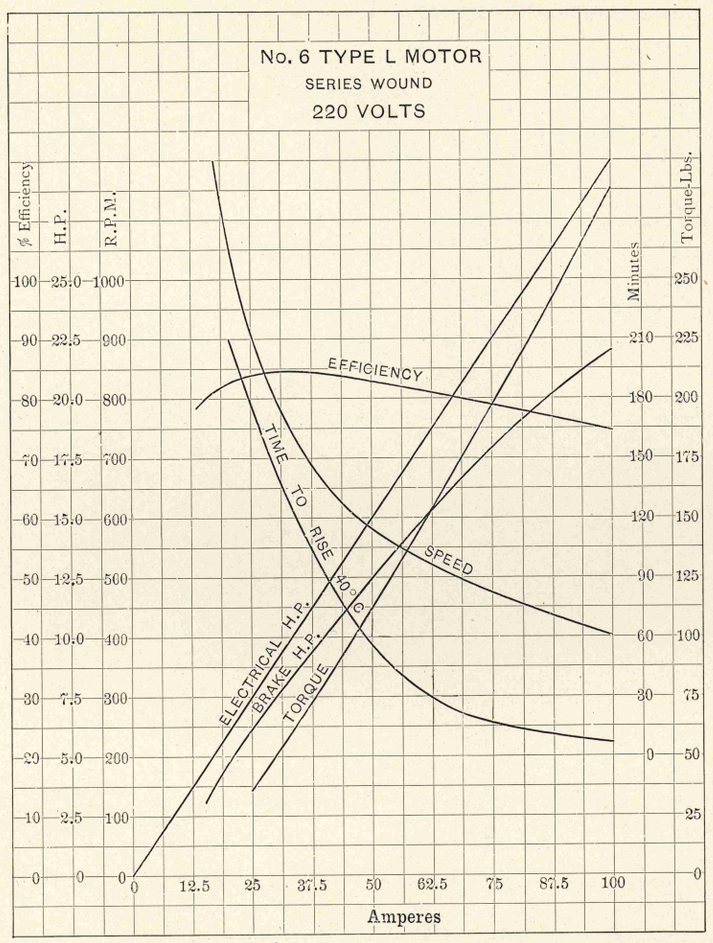
No. 3 Type L Motor.



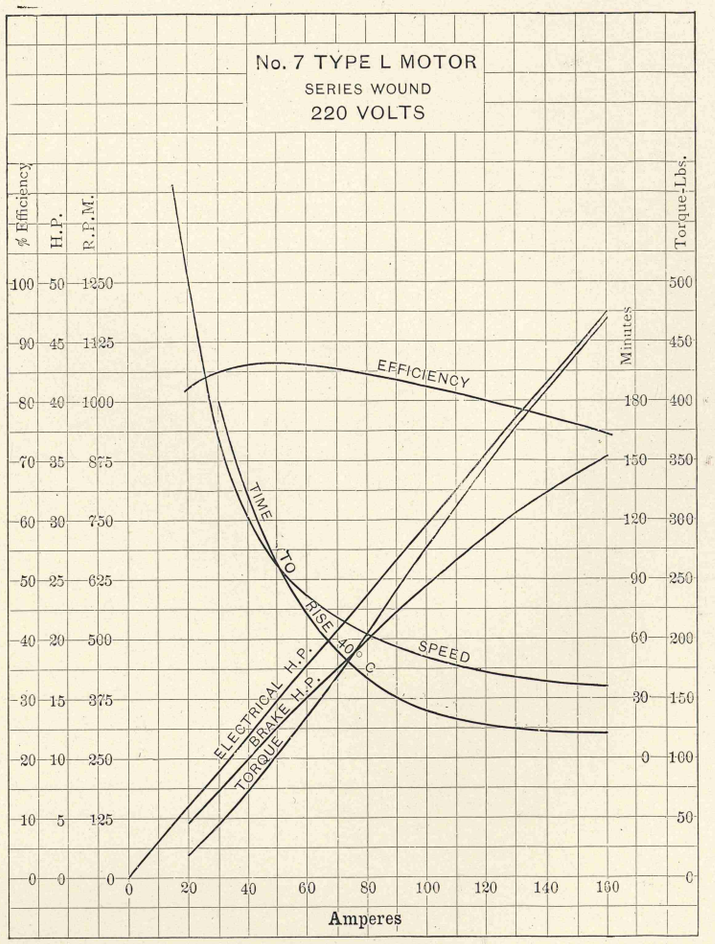
No. 4 Type L Motor.



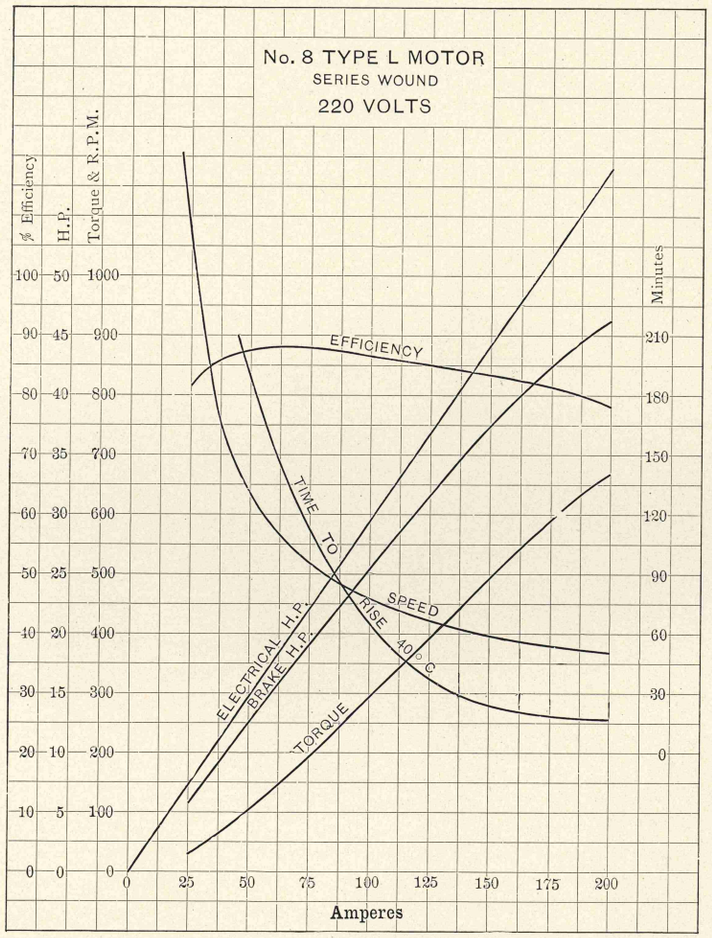
No. 5 Type L Motor.



No. 6 Type L Motor



No. 7 Type L Motor.



No. 8 Type L Motor.

LIST OF CIRCULARS IN FORCE MARCH 1st, 1904

Numerically Arranged

Circular No.	SUBJECT
1001.	Belt-Driven Railway Generators.
1015.	Transformer Fuse Blocks—1000-3000 Volts.
1017.	Alternating-Current Potential Regulators.
1026.	Compensators for Alternating-Current Circuits.
1027.	Incandescent Street Lighting System.
1028.	Rotary Converters.
1031.	Belt-Driven Polyphase Alternators, Rotating Armature Type.
1032.	The Westinghouse No. 56 Railway Motor.
1033.	Direct Current Engine-Type Generators—125 Volts and 250 Volts.
1035.	The Westinghouse No. 12A Railway Motors.
1036.	Belt-Driven Single-Phase Alternators—16000 and 7200 Alternations.
1037.	Engine-Type Alternators.
1038.	The Westinghouse No. 49 Railway Motor.
1039.	The Westinghouse No. 38B Railway Motor.
1040.	Self-Cooling Transformers.
1042.	Multipolar Generators and Motors.
1044.	Direct-Connected Railway Generators.
1045.	Lightning Protection.
1048.	The Westinghouse No. 68 Railway Motor and 68C Railway Motor.
1050.	Polyphase Induction Motors—Type C.
1053.	The Westinghouse No. 69 Railway Motor.
1057.	O D Transformers.
1058.	The Westinghouse No. 76 Railway Motor.
1059.	Electric Motor-Vehicle Equipments.
1060.	Type N Transformers.
1061.	Westinghouse Automobile Charging Outfits.
1062.	Type F Induction Motors—Variable Speed.
1066.	Type H Induction Motors.
1067.	Air Blast Transformers.
1068.	Type S Motors—Direct Current.
1077.	Type L Motors—Direct Current, Series Wound.

Note—This series began with Circular No. 1000. All numbers not included in this list have either been superseded or discontinued.

Alphabetically Arranged According to Subject

	Circular No.
Air Blast Transformers	1067
Alternating-Current Compensators	1026
Alternating-Current Engine-Type Alternators	1037
Alternating-Current Induction Motors—Type C	1050
Alternating-Current Lightning Arresters	1045
Alternating-Current Potential Regulators	1017
Alternators, Belt-Driven Single-Phase—16000 and 7200 Alternations	1036

Alternators, Belt-Driven Polyphase, Rotating Armature Type 1031
Alternators, Engine Type 1037
Automobile Charging Outfits 1061
Automobile Equipments 1059
Belt-Driven Polyphase Alternators, Rotating Armature Type 1031
Belt-Driven Railway Generators 1001
Belt-Driven Single-Phase Alternators—16000 and 7200 Alternations 1036
Charging Outfits for Automobiles 1061
Choke Coils, for Alternating Current and Direct Current 1045
Compensators for Alternating-Current Circuits 1026
Converters, Rotary 1028
Direct-Connected Railway Generators 1044
Direct-Current Belt-Driven Railway Generators 1001
Direct-Current Engine-Type Generators—125 Volts and 250 Volts 1033
Direct-Current Lightning Arresters 1045
Direct-Current Multipolar Generators and Motors 1042
Electric Motor-Vehicle Equipments 1059
Engine-Type Alternators 1037
Engine-Type Generators, Direct Current—125 Volts and 250 Volts 1033
Engine-Type Generators, Direct-Current—500 Volts 1044
Fuse Blocks, Transformer 1015
Generators, Belt-Driven Polyphase, Rotating Armature Type 1031
Generators, Belt-Driven Railway 1001
Generators, Belt-Driven Single-Phase—16000 and 7200 Alternations 1036
Generators, Direct-Connected Railway 1044
Generators, Direct-Current Engine-Type—125 Volts and 250 Volts 1033
Generators, Multipolar-Belted Type 1042
Incandescent Street Lighting System 1027
Induction Motors, Polyphase—Type C 1050
Induction Motors—Type F—Variable Speed 1062
Induction Motors—Type H 1066
Lighting System, Incandescent Street 1027
Lightning Protection 1045
Motors—Induction—Type F 1062
Motors—Induction—Type H 1066
Motors, Multipolar—Belted Type 1042
Motors—Polyphase Induction—Type C 1050
Motors, The Westinghouse No. 12A Railway 1035
Motors, The Westinghouse No. 38B Railway 1039
Motors, The Westinghouse No. 49 Railway 1038
Motors, The Westinghouse No. 56 Railway 1032
Motors, The Westinghouse No. 68 Railway and 68C Railway 1048
Motors, The Westinghouse No. 69 Railway 1053
Motors, The Westinghouse No. 76 Railway 1058
Motors—Type L 1077
Motors—Type S 1068
Motor-Vehicle Equipments 1059
Multipolar Generators and Motors—Belted Type 1042

O D Transformers 1057
Polyphase Alternators, Belt-Driven, Rotating Armature Type 1031
Polyphase Induction Motors—Type C 1050
Potential Regulators, Alternating-Current 1017
Protection, Lightning 1045
Railway Generators, Belt-Driven 1001
Railway Generators, Direct-Connected 1044
Railway Motors, The Westinghouse No. 12A 1035
Railway Motors, The Westinghouse No. 38B 1039
Railway Motors, The Westinghouse No. 49 1038
Railway Motors, The Westinghouse No. 56 1032
Railway Motors, The Westinghouse No. 68 1048
Railway Motors, The Westinghouse No. 69 1053
Railway Motors, The Westinghouse No. 76 1058
Regulators, Alternating-Current Potential 1017
Rotary Converters 1028
Rotating Armature Type Belt-Driven Polyphase Alternators 1031
Self-Cooling Transformers 1040
Single-Phase Alternators, Belt-Driven—16000 to 7200 Alternations 1036
Street Lighting System, Incandescent 1027
System, Incandescent Street Lighting 1027
Transformer Fuse Blocks 1015
Transformers, Air Blast 1067
Transformers, O D 1057
Transformers, Self-Cooling 1040
Transformers, Type N 1060
Type C Motors—Polyphase Induction 1050
Vehicle-Motor Equipments 1059

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Circular 1077 — March, 1904

TYPE L MOTORS
Direct Current Series Wound

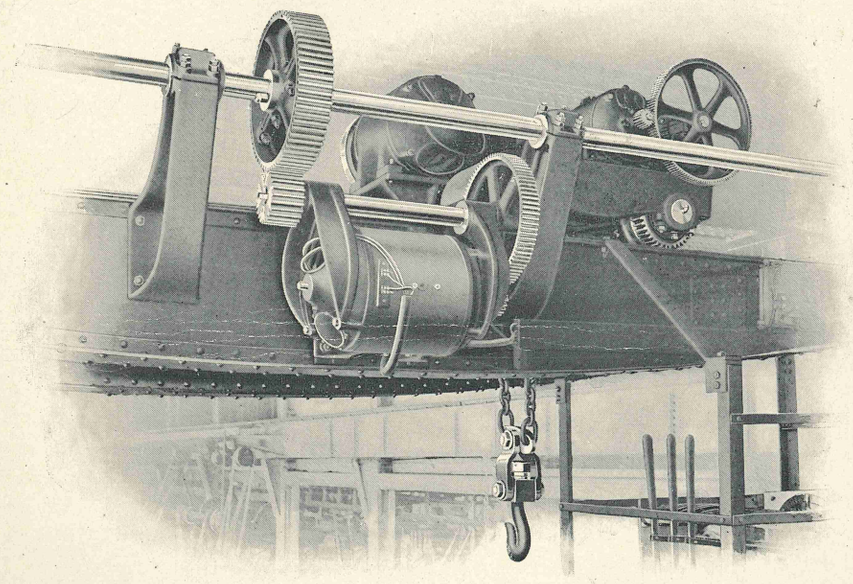

FIG. 1—ELECTRIC CRANE DRIVEN BY TYPE L MOTORS